

# **T-958' Fast Timing R&D**

**Ian Howley (UTA) Andrew Brandt (UTA) for  
AFP Timing Group: Alberta, Giessen, Saclay, Stony Brook, UTA**

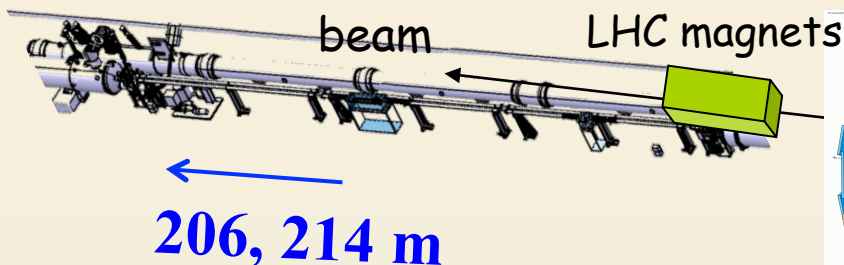
**T-958 Originally formed for FP420 timing R&D ( a joint ATLAS/CMS effort  
focused on diffractive Higgs) using Cherenkov light/ Microchannel Plate PMT**

**CMS timing group (Albrow) joins with Ronzhin, Ramberg, Chicago to form  
T-979 focus on different detectors/siPM while ATLAS group focuses on MCP-  
PMT development/electronics chain/laser tests**

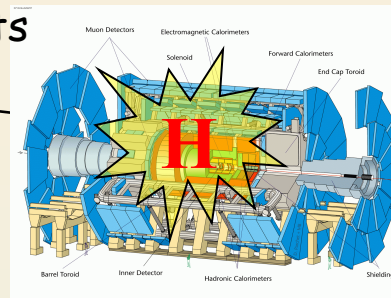
**Many thanks to all of the FTBF team for a great facility at a  
fantastic week of beam!**

# Atlas Forward Protons (AFP)

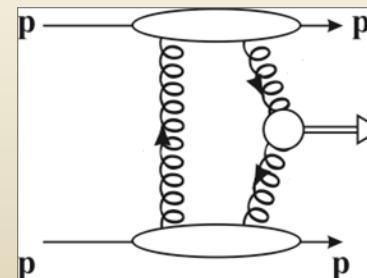
AFP: a set of spectrometers that use points measured along the trajectory of scattered protons along with the LHC lattice to tag and measure their momentum and scattering angle.



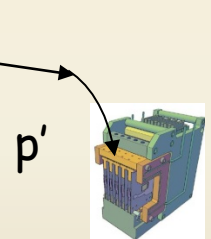
Conceived for  
diffractive Higgs  
 $pp \rightarrow pHp$



Central  
Exclusive  
Production  
(QCD)



Detector stations  
~210m from IP



NEW

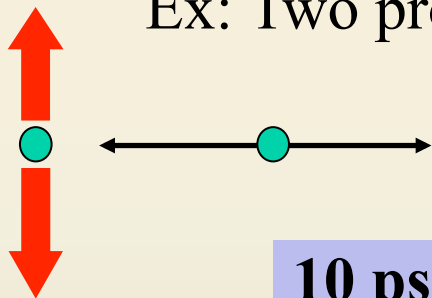
**CEP: Momentum lost by protons goes entirely into mass of central system**

# Fast Timing Detector Motivation...

**Pileup background rejection/signal confirmation**

**Use arrival time difference between protons to measure z-vertex compared with the central tracking primary vertex**

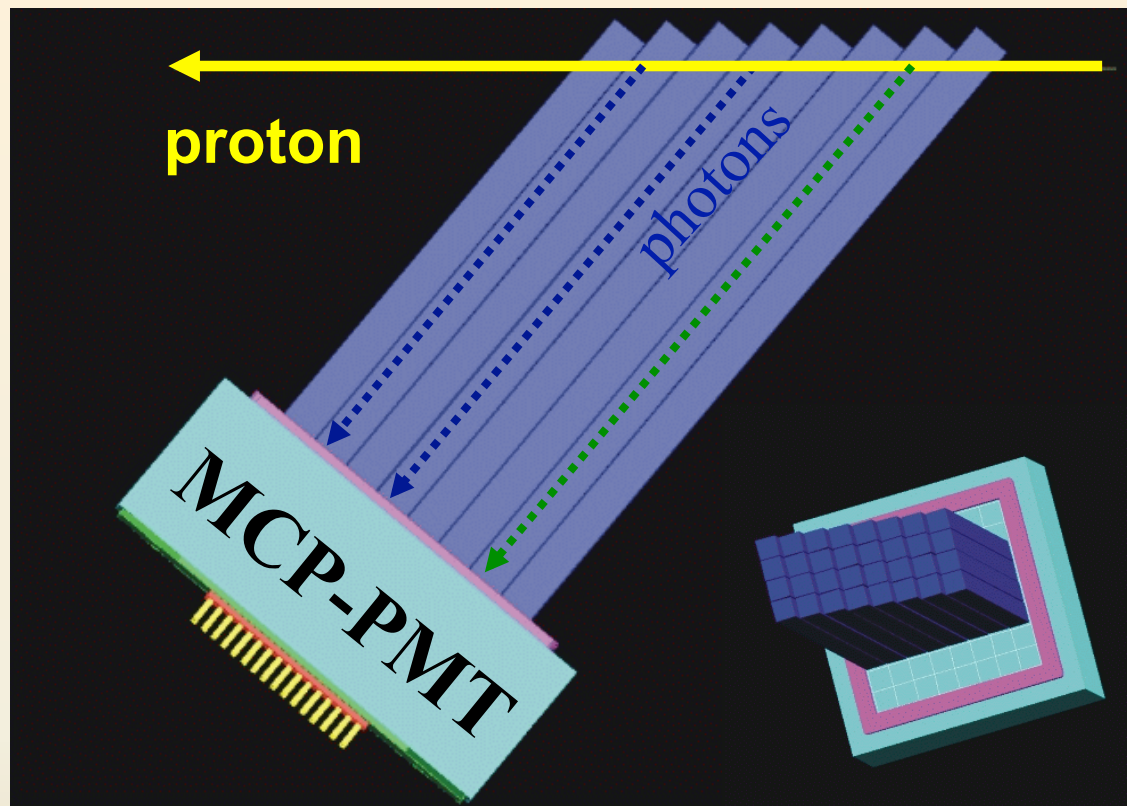
Ex: Two protons from one interaction and two jets from another



## and Requirements

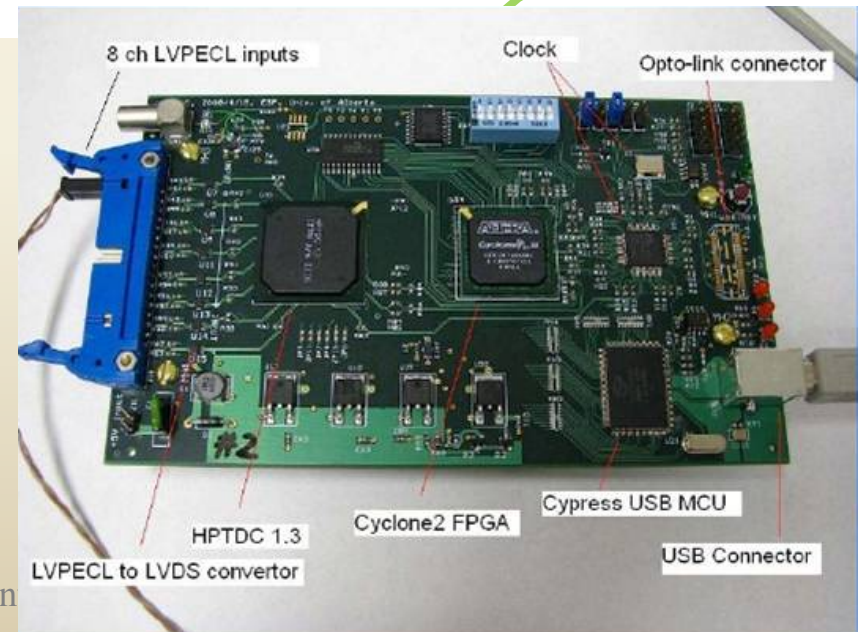
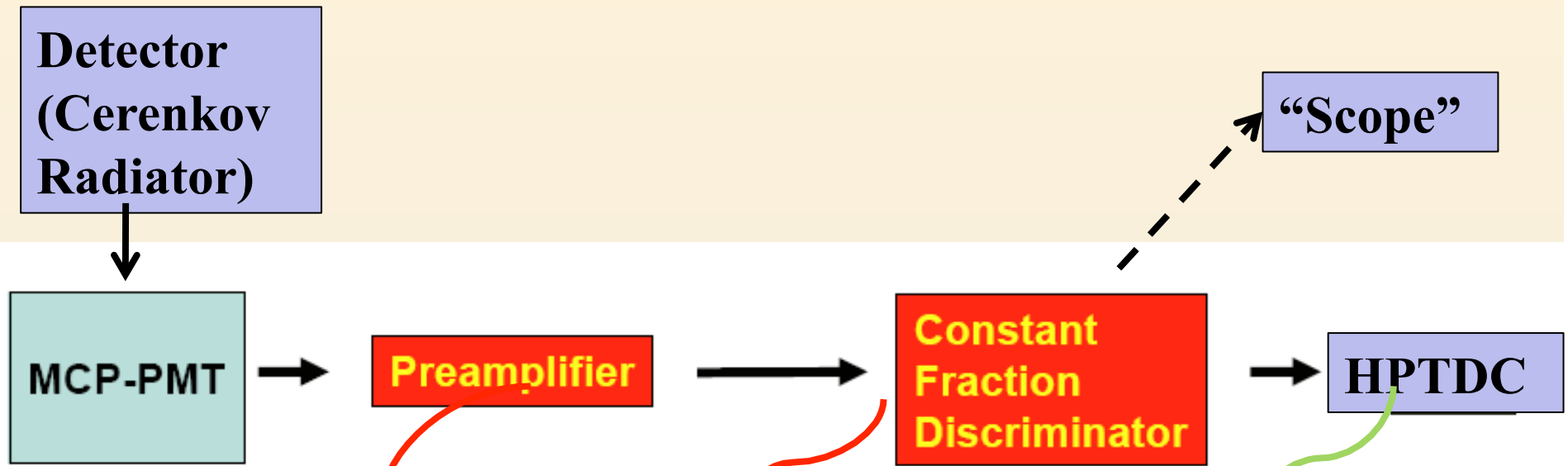
- 10 ps resolution (including electronics)**
- High efficiency and acceptance**
- High rate capability (~5 MHz/pixel)**
- Segmentation for multi-proton timing**
- L1 trigger capability**
- Robust operation in high radiation environment**

# Proposed AFP Timing Detector (QUARTIC)



**Only need a 30 ps measurement, as each proton goes through 8 bars**

# Components of AFP Fast Timing





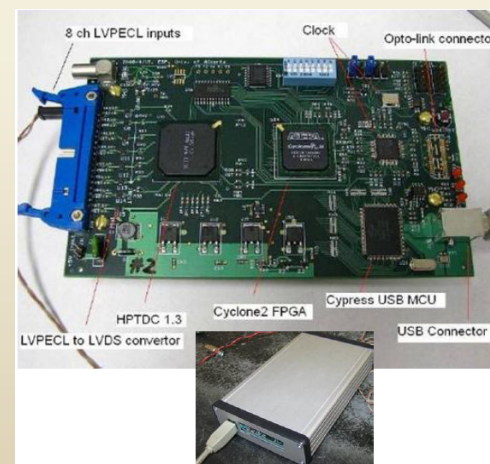
# T958 DAQ



**Just your garden variety  
20 channel, 20 GHz/ch,  
40 Gs/s channel (point every 25  
ps) 500k\$ LeCroy 9Zi scope!**

**Thanks to LeCroy for lending it  
to us for the week!**

**Also used  
HPTDC  
readout**



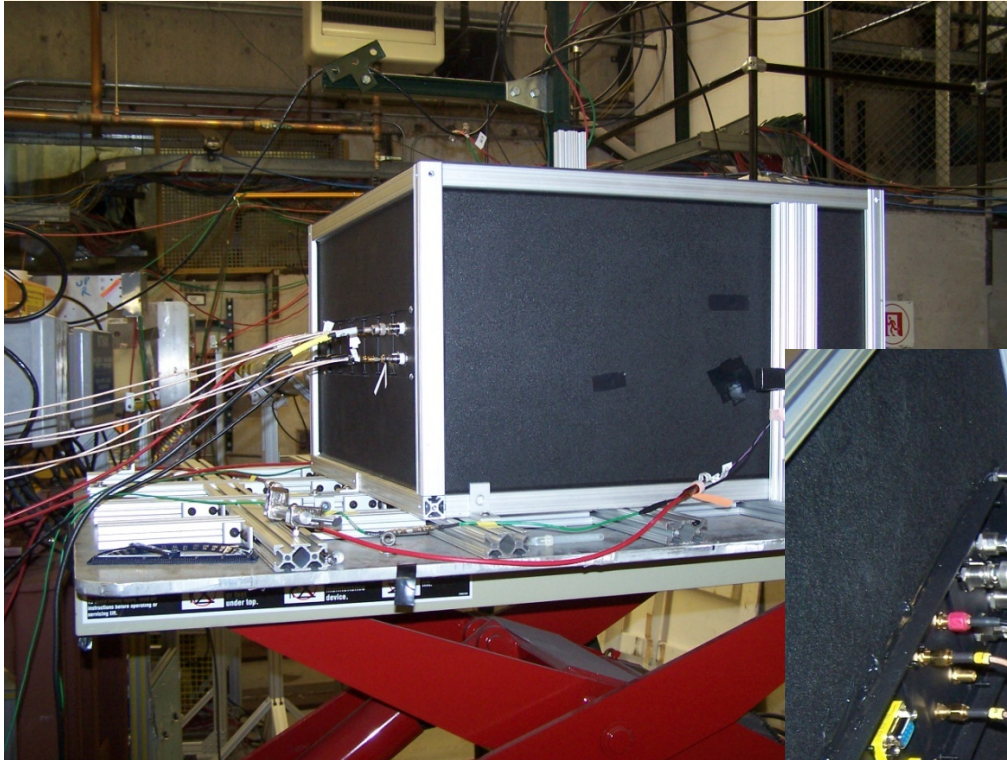
# Jan 3-10 2012 Test Beam@Fermi

## **GOALS:**

- 8 channel test with 5x5 mm ~10 cm long quartz bars
  - Compare analog and digital results with LeCroy 9ZI super oscilloscope
  - Full electronics chain test AMP/CFD/HPTDC
- Test Giessen Fiber QUARTIC
- Various other test to help optimize detector design



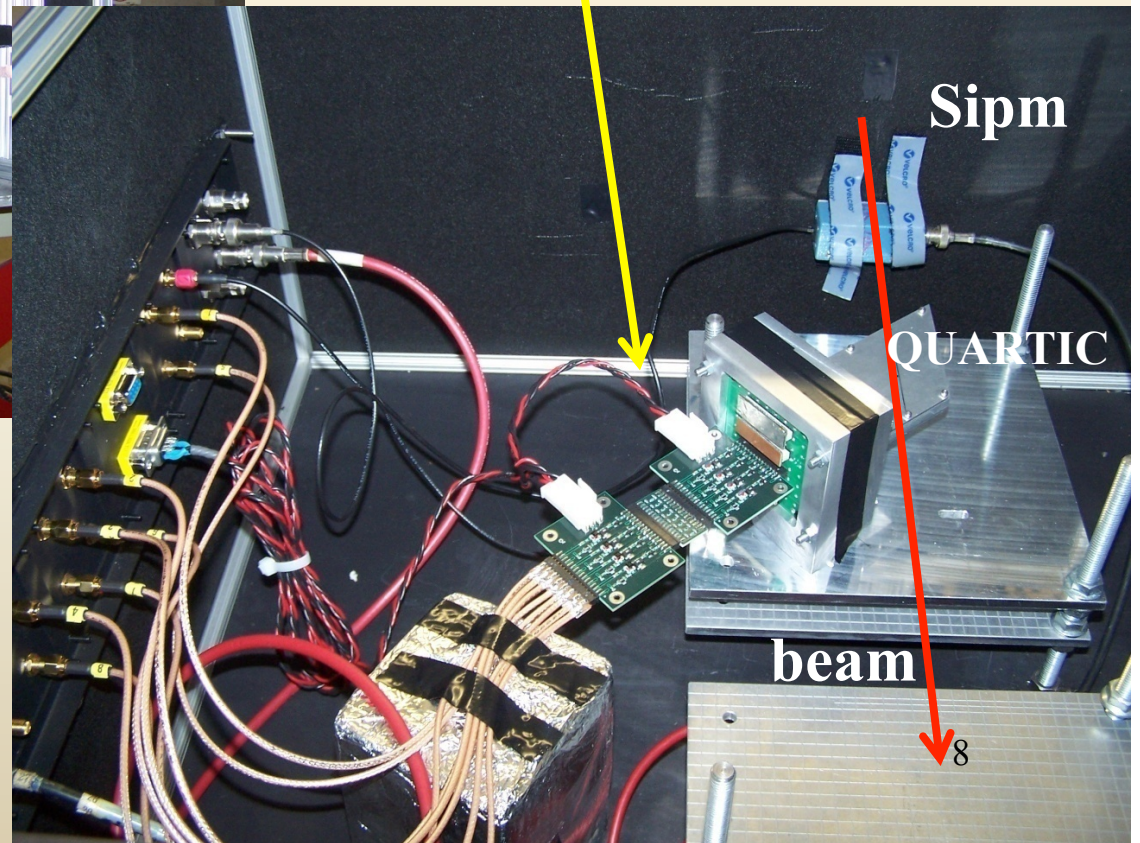
# New Test Beam Setup



**New Stony Brook  
Amp cards plug  
directly onto PMT**

**Prepared @UTA for easy  
alignment and versatility**

January 23, 2012

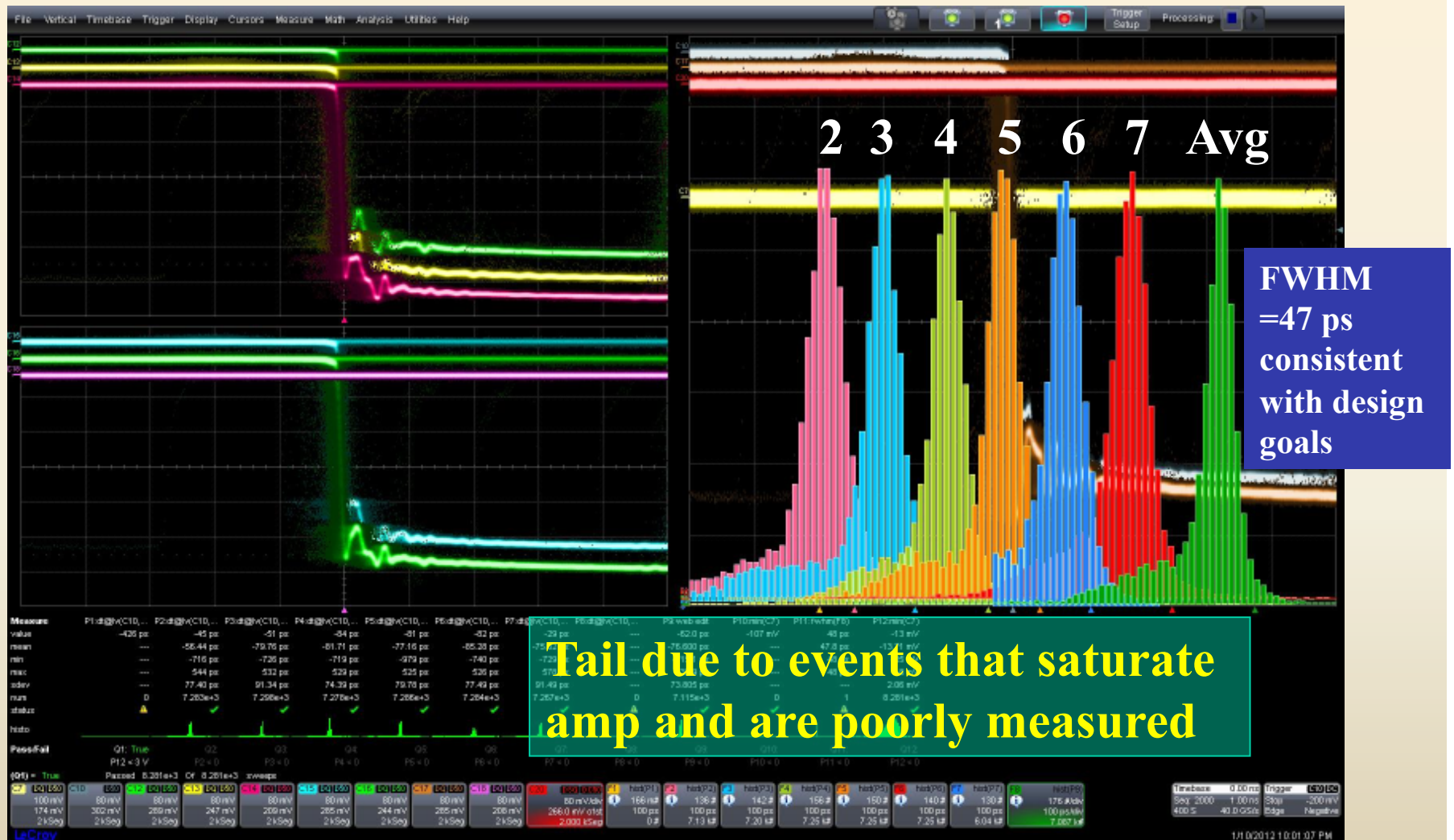




# 19 Nsec Bunch Structure



# Quartic bars compared to reference detector





# UTA Grad Students at work



January 23, 2012

Andrew Brandt / All Experimenters' Meeting



# And posing with the star

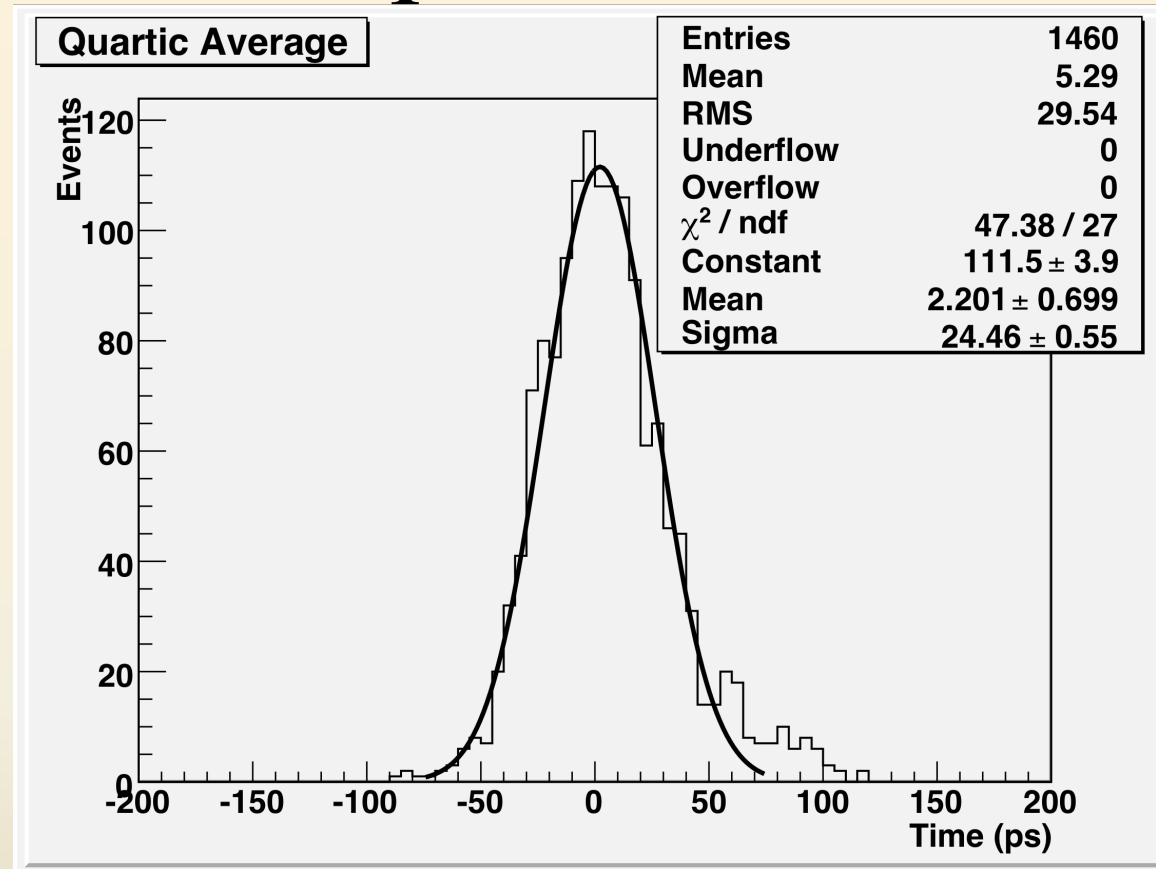


January 23, 2012

Andrew Brandt All Experimenters Meeting



# A First pass at the data



Require at least 4 quartic hits + SiPM, and  
some removal of poorly measured Si events<sub>13</sub>

# Conclusions

- Analysis is ongoing
- Preliminary results show promising time measurements on par with our design goals
- Thank you again to the devoted FTBF staff, we appreciate the opportunity and look forward to future test beams